Optometry.

half-hoop of the perimeter is usually made of brass, and is rather heavy; one-half of a hoop of a cheese-box, stiffened at the back by a piece of thin board sawed to the proper curve, answers every purpose in practice; the points are determined by moving a bit of chalk or a small square of white cardboard along the blackened arc.

FIG. 3694.

Instead of the small square of cardboard a small electric lamp, the intensity of which may be regulated at will by means of a rheostat or by varying the internal resistance of the battery, may be used in determining the limits of the visual field in cases of cataract or other obscuration of the media; a candle may be used for the same purpose.

For testing the limits of the field for color perception, small pieces of colored cardboard, usually 1 cm. square, are used instead of the bit of chalk or square of white card. A small convex mirror of very short radius of curvature, such as the bulb of a thermometer, may also be used to reflect white or colored light from a lamp placed a little above and behind the patient's head.

The perception of form in the peripheral regions of the retina is tested by means of two small black squares on a white ground, with an interspace equal to one of the squares (Fig. 3694). These squares, of sizes corresponding to the thickness of the limbs of Snellen's test letters (Nos. XX. to C.), are moved along the arc of the perimeter toward the centre of the field, until the white interval is seen between the two black squares.

Dioptometry—from διά, through—has to do with the eye considered as an optical instrument, with especial reference to the detection and measurement of the different anomalies of refraction and accommodation. The detection, measurement, and correction of the several anomalies of refraction and accommodation are treated in this HANDBOOK under the titles, *Accommodation and Refraction*, *Astigmatism*, *Hypermetropia*, *Myopia*, and *Presbyopia*.

Dioptometry is either objective or subjective, according as the investigation turns upon observations made by the examiner or by the person examined. The objective methods are of the wider applicability, inasmuch as they may be employed in cases in which the patient is incapable either of making accurate observations or of accurately reporting his observations; subjective determinations have, on the other hand, the special advantage that they are the actual measurements of the function performed by the eye under examination. Objective examination affords, in many cases, the readiest means of discovering and of approximately measuring a refractive anomaly, and is often of service as a guide to the examiner in the conduct of such tests as require the active co-operation of the patient.

In objective examinations the chief dependence is upon the ophthalmoscope (see *Ophthalmoscope*, also *Shadow-Test*). A second method, based upon the observation of the images formed by reflection at the anterior surface of the cornea, and therefore suited to the detection of deviations from normal curvature of the first and most important of the refracting surfaces of the eye, demands notice in so far as it may be employed in clinical investigations.

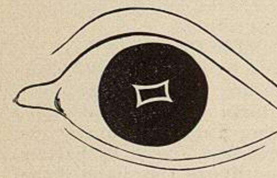

FIG. 3695.

The image of a luminous point or small flame, as it is seen mirrored by a cornea of irregular curvature, undergoes conspicuous changes of form according as the reflection is from one or another part of the corneal surface. This is especially noticeable in irregularity of contour resulting from the cicatrization of a corneal wound or ulcer, or from distention of the corneal tissue as a result of softening from disease. It is also very characteristic in keratoconus (conical cornea), in which affection the principal image remains nearly in one position, at the rounded vertex of the cone, whatever the direction from which the light is thrown upon it. When the light falls upon the cone from the side, two images are often seen, the one small and nearly central, corresponding to the vertex of the cone, the other lateral and distorted, formed by reflection on the side of the cone nearest the light. In regular astigmatism, in which asymmetry of the cornea is ordinarily the most important factor, the image of the point of light appears drawn out in a direction corresponding to one of the two principal meridians; when two lights are used, their images will be seen to be appreciably nearer together when they lie in the plane of the corneal meridian of greatest refraction than when they lie in the plane of the meridian of least refraction. Inasmuch as the distance which separates the two images is determined by the corneal curvature in the meridian in which they lie, it is possible, by measuring this distance, to obtain the necessary data for calculating the radius of curvature. The ophthalmometer of Helmholtz,[18] adapted by Donders and Middelburg[19] to the investigation of the curvature of the cornea in its different meridians, is an instrument by the aid of which such measurements may be made with almost the accuracy of an astronomical observation.

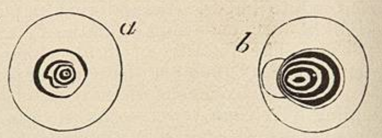

FIG. 3696.

If a rectangular white card is held at a distance of a few inches in front of an eye, the image, as seen reflected on the cornea, will appear more or less distorted whenever the corneal curvature is either irregular or asymmetrical. The most striking distortions are observed in conical cornea and in astigmatism; in the former condition the four straight sides of the card appear incurved in the direction of the vertex of the cone (Fig. 3695); in the latter condition a square card is reflected as a parallelogram, and a circular card as an oval.

This experiment is further developed in the keratoscopic disc of Placido,[20] a circular card or metal disc, about 23 cm. in diameter, with concentric rings painted in black and white upon the side turned toward the eye to be examined. The observer, looking through a central hole in the disc, sees an image formed by reflection on a large central area of the cornea; the effect of any asymmetry or distortion of the reflecting surface is revealed by a characteristic asymmetry or distortion of the image (Fig. 3696).

FIG. 3697.

In the "astigmometer" of De Wecker and Masselon[21] a square black card with a white border 1.5 cm. in width is held before the eye to be examined, and the form of the image of the white border noted, as shown in Fig. 3695.

The ophthalmometer of Javal and Schiötz[22] is a simplification of the Donders-Middelburg modification of the ophthalmometer of Helmholtz; instead of lights, special test objects (*mires*) of enamelled metal are used, and the images are viewed through a small telescope which contains a doubly refracting prism, by means of which the images are doubled and brought into such relation to each other that their mutual distance can be ascertained at a glance. The several parts of the instrument are so proportioned that the refraction for any meridian may be read off in dioptries without the trouble of making calculations (see *Ophthalmometer*).

In the ophthalmophakometer of Tscherning (1900), small adjustable electric lamps are carried on an arc like

Optometry.

that of the Javal-Schiötz ophthalmometer. By means of this instrument Tscherning has succeeded in measuring the curvatures of the posterior surface of the cornea and of the two surfaces of the crystalline lens. The ophthalmophakometer, like the ophthalmometer of Helmholtz, is adapted rather to accurate research work in the physiological laboratory than to clinical use.

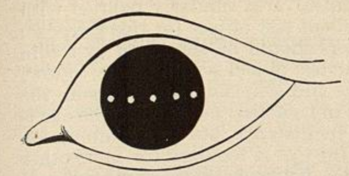

FIG. 3698.

The *arc keratoscopique* of De Wecker and Masselon (Fig. 3697)[23] is a simplification of the ophthalmometer of Javal and Schiötz; a number of small white discs, arranged at equal distances upon a blackened arc like the arc of a perimeter, give reflections in which the interspaces are nearly equal when the curvature of the cornea is regular, but unequal when the curvature changes from the centre toward the periphery (Figs. 3698 and 3699). The instrument is especially adapted to the detection of conical cornea.

In subjective dioptometry we distinguish methods which turn upon the recognition of the forms of test objects, such as the test letters of Snellen, and methods in which the accurate recognition of form is not required.

In any case in which the acuteness of vision is normal, the detection and measurement of simple ametropia (H or M) may be made by means of trial glasses used in connection with the test letters of Snellen. Having placed the patient at a measured distance of 5 metres from the card of test letters, we note the smallest line of letters which he is able to read correctly with the unaided eye. If by this test we find $V. = \frac{5}{5}$, the presence of myopia of any grade in excess of 0.02 dioptrie is excluded, and the eye is either practically emmetropic or hypermetropic with accommodative power in excess of its hypermetropia ($A > H$). To decide between these two possible conditions we place a weak convex glass before the eye and note whether there is any falling off in the acuteness of vision at the distance of the test card. If we still find $V = \frac{5}{5}$, the presence of some degree of hypermetropia is established, and we exchange the convex glass for another of greater power, until we have hit upon the strongest convex glass through which V remains at the normal standard $\frac{5}{5}$. The value of this convex glass in dioptries * is the measure of the manifest hypermetropia.

Whenever, by the use of the test letters, we find $V < \frac{5}{5}$ we suspect the presence of myopia, and proceed at once to try the effect of a weak concave glass. If V is improved by this glass we try stronger glasses in succession, until we have found the weakest concave glass through which $V = \frac{5}{5}$. The value of this concave glass in dioptries † is the measure of the myopia (M), or possibly of the myopia augmented by some degree of abnormal tension of the accommodation.

In order to measure the total hypermetropia (Ht), and sometimes, also, to obtain the true measure of a myopia, it is necessary to bring the eye under the full influence of one of the stronger mydriatics, and to repeat the examination with the test-letters. The problem is so far simplified by the suppression of the accommodation that it is now only a question of what glass, whether convex or concave, raises V to its maximum at the distance of the test card.

If no glass suffices to raise V to the normal standard of $\frac{5}{5}$, and especially if the patient is in doubt as to which of several glasses of somewhat different power gives the best visual result, we may suspect the presence of astigmatism. The special methods used for the detection and measurement of astigmatism have been described under that title (see *Astigmatism*).

A large collection of trial lenses is an indispensable

* Less 0.2 dioptrie, as a correction for the distance of the test object.
† Plus 0.2 dioptrie, as a correction for the distance of the test object.

part of the armamentarium of the ophthalmic practitioner, and it is convenient to include in it the full range of numbers as found in commerce, or for which grinding tools are kept by the working opticians. With such a series of spherical lenses (in pairs), ranging (through zero) from + 20 to − 20 dioptries, and a full series of cylindrical lenses (in pairs), ranging from + 10 to − 10 dioptries, it is possible to correct almost any case of simple hypermetropia, myopia, or astigmatism by means of a single glass for each eye, and, similarly, to correct any case of compound or of mixed astigmatism by means of a combination of two glasses for each eye. The lenses of the trial case should be accurately centred, and set in brass cells turned with a thin projecting flange (like the wheels of a railway carriage) so that any two may be provisionally mounted, with the two flanges in contact, in a trial frame made with a single groove.[24] In the higher numbers of each series the lenses should be of the plano-convex and plano-concave form, and they should be so set in their cells as to bring their plane surfaces very nearly in contact when any two lenses are used in combination, thus making it possible to build up any desired double convex, double concave, or periscopic lens, or by combining a plano-spherical with a plano-cylindrical lens, to build up any required spherico-cylindrical lens with the same combination of surfaces as in the lens to be prescribed.*

The trial frames should be of the lightest practicable weight and of the simplest possible construction. For most purposes a single groove, made wide enough to receive the thin flanges of two lenses, is sufficient. A dozen or two of such frames, of different widths and height of bridge, costs no more than one or two of the complicated and less convenient trial frames shown in almost endless variety in the catalogues of the manufacturing opticians.

By enlarging the series of test letters through the addition of a few numbers, so as to extend its range to say 0.1 metre, the position of the near-point (p) may be approximately determined by direct observation. Oftener, however, we determine the position of p after having provisionally corrected the eye for distant vision by means of glasses; for practical purposes it is generally sufficient to measure the distance (P_2) of the binocular near-point (p_2) from the anterior nodal point of the eye (see *Accommodation and Refraction*).

It is possible to use the card of test letters for the direct determination of the grade of myopia, by noting the greatest distance at which the letters corresponding to that distance are distinctly recognized. In the lower grades of myopia good measurements may sometimes be made in this manner, but in the higher grades the convergence of the visual axes is apt to be attended with some exercise of the accommodation, so that the measurements are often somewhat in excess of the actual myopia.

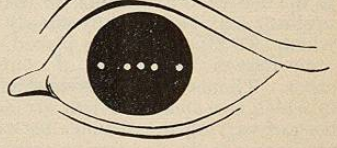

FIG. 3699.

* The following specification of a series of trial lenses has been found satisfactory in practice:

Spherical lenses, in pairs: + 2.0 D, through 0, to − 2.0 D, with a common interval of 0.125 D (thirty-three pairs); + and − 2.25 D to + and − 7.0 D, with a common interval of 0.25 D (forty pairs); + and − 7.5 D to + and − 12 D, with a common interval of 0.5 D (twenty pairs); + and − 13.0 D to + and − 20.0 D, with a common interval of 1.0 D (sixteen pairs); + and − 22.0 D (two pairs); + and − 24 D (two pairs):—total, 113 pairs of spherical lenses.

Cylindrical lenses, in pairs; + and − 0.125 D to + and − 2.0 D, with a common interval of 0.125 D (thirty-two pairs); + and − 2.25 D to + and − 7.0 D, with a common interval of 0.25 D (forty pairs); + and − 7.5 D to + and − 10.0 D, with a common interval of 0.5 D (twelve pairs); + and − 11 D to + and − 14 D, with a common interval of 1.0 D (eight pairs):—total, 92 pairs of cylindrical lenses.

The entire collection of 205 pairs of lenses, together with a series of prisms, in pairs ranging from 1° to 12° angle, is contained in a box measuring 47 × 42 × 6.5 cm.; for convenience in keeping the case free from dust, the lenses are arranged in a bottomless tray which may be lifted out of the box.

Optometers for the measurement of the refraction, and also of the range of accommodation, at some short distance, say, of one foot, have been made in a great variety of forms; they are, however, of much less value than might be expected, whether as regards saving of time in

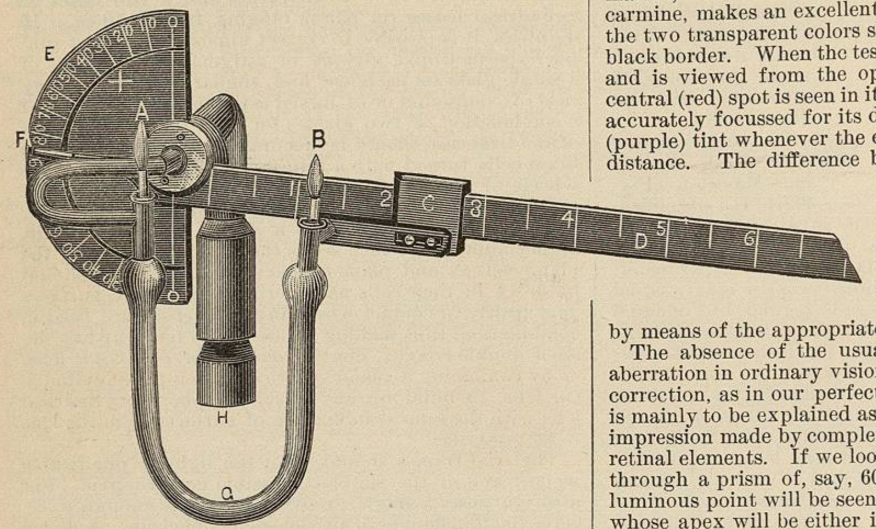

FIG. 3700.

observation or accuracy of results. The binocular optometer of Javal (see Vol. I., p. 594), especially devised for the measurement of astigmatism, probably still remains the best instrument of its class.

A point of light, such as the flame of a small taper or gas jet, viewed from a distance of 5 metres or more, is seen by an emmetropic eye as a bright point, with some indication of bright rays, as in the familiar picture of a star (see Vol. I., 596). The same distant bright point is seen by a myopic eye, or by a hypermetropic eye in a state of accommodative relaxation, as a bright spot (circle of confusion) of a greater or less diameter, dependent on the grade of ametropia and the size of the pupil. When the pupil is fully dilated by a mydriatic, the size of the circle of confusion is approximately proportionate to the degree of ametropia, so that a pretty exact measurement may be made by simply noting the distance at which two tapers must be placed, one from the other, in order that the two circles of confusion may touch each other. Thomson[25] has devised as apparatus (Fig. 3700) in which two small gas jets are so arranged as to admit both of varying the distance between the two lights and of altering their direction to correspond to different ocular meridians; the degree of ametropia is read off from a scale which forms a part of the instrument.

By making the effective area of the pupil very small, as in looking through a pinhole pricked in a blackened card, the circles of confusion may be so reduced in size as to admit of tolerably distinct vision even in high grades of ametropia. If two pinholes are pricked in the card, at a distance of, say, 4 mm. from each other, a pretty distinct image will be formed by the rays passing through each of the pinholes, but the two bundles of rays will fall upon different parts of the retina whenever the eye is adjusted for any distance other than that of the object (Fig. 3701). This experiment, first described by Scheiner,[26] has been utilized in the optometers of Porterfield[27] and Young,[28] and has been further developed in a method for the clinical investigation of ametropia by Thomson.[29]

When a colored test object, in a field of a contrasting color, is viewed by an eye adjusted for some distance other than that of the object, the circles of confusion, representing parts of the object and of the field adjacent to the line of demarcation of the two colors, overlap in the retinal image and form the combination color proper to the mixture. The experiment succeeds best when the test object and the contrasting field are in transparent colors and viewed by transmitted light. A sheet of ground glass coated with varnish colored blue by ultramarine, with a small central area similarly painted with carmine, makes an excellent test object for this purpose; the two transparent colors should be separated by a thin black border. When the test object is hung in a window, and is viewed from the opposite side of the room, the central (red) spot is seen in its actual color when the eye is accurately focussed for its distance, but in a combination (purple) tint whenever the eye is focussed for some other distance. The difference between the carmine-red and the combination-purple is especially striking in astigmatism, when the test object is made up of radiating lines of carmine, on a blue field[30] and the eye is corrected for one of its principal meridians by means of the appropriate spherical glass.

The absence of the usual phenomena of chromatic aberration in ordinary vision is not due to an achromatic correction, as in our perfected dioptric instruments, but is mainly to be explained as an effect of the simultaneous impression made by complementary colors upon the same retinal elements. If we look at a distant point of light, through a prism of, say, 60° angle, the spectrum of the luminous point will be seen under the form of a triangle, whose apex will be either in the red or in the violet, according as "the focus of the eye is adapted to collect the red or the blue rays to a point";[31] in other words, according as the eye is slightly myopic or hypermetropic. In emmetropia the spectrum is seen under the form of a double triangle in which the narrowest part lies in the very strongly luminous yellow region. The impression made by a point of white light upon any single cone of the retina is, therefore, compounded of the spectral yellow and a composite yellow, made up of red and green. This mixed yellow, superimposed as it is, upon a field of diffused violet, is further modified to approach white.

The chromatic aberration of the eye reveals itself very plainly in looking at a point of light of which all but the blue and red rays have been extinguished by the passage of the beam through a sheet of cobalt-blue glass.[32] Looking through such a glass an emmetropic eye, focussed for the distance of the light, sees it of a nearly uniform purplish-blue tint, with an inconspicuous halo of a clearer blue; a myopic eye sees the same light red, with a blue halo; and a hypermetropic eye, uncorrected by accommodation, sees it blue, with a red halo. To measure the grade of the ametropia it is sufficient to find the spherical (concave or convex) glass through which the light appears of a purplish-blue bordered by a clearer blue.

An emmetrope, looking at distant red and green lights, such as are carried by vessels and used as railway signals, sees the two lights of about the same magnitude; a myope sees the green light as an aggregation of circles of confusion, and therefore larger than the image of the red light; a hypermetrope, with imperfect accommoda-

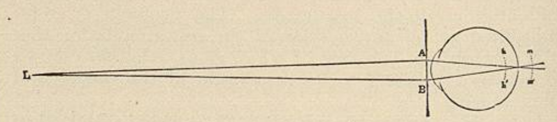

FIG. 3701.

tion, sees the red light larger than the green. When the vision is corrected for the distance of the lights they are seen in their normal relation of equality in size.[33] *

* The difference in the size and definition of the retinal image of a red and of a green light is quite sufficient to enable a hypermetropic or slightly myopic pilot, or railway employee, to utilize this difference as an aid to the discrimination of lantern signals, even though he be color-blind.

Ophthalmostatometry—from ὀφθαλμός, eye, and στα-, root of ἵστημι, to stand—is the measurement of the position of the eyes. The most important measurements are those which have to do with the two eyes in respect of their mutual distance and the relative direction of the visual axes.

The distance between the two eyes may be roughly measured by looking the patient in the face and letting him direct his gaze alternately upon the two eyes of the observer, who in turn reads off the position of the fixing eye with his fixed eye upon a graduated rule held in the hand or mounted like a spectacle frame. The right or left corneal margins, or the right or left margins of the pupils, may be taken as fixed points whose mutual distance is an approximate measure of the true interocular distance. An inaccuracy of this, as of other objective methods of measuring the interocular distance, arises from the fact that the visual axis does not exactly coincide with the geometrical axis of the eye, but, as a rule, cuts the cornea a little to the inner (nasal) side of its vertex. The angle which the visual axis makes with the axis of the cornea (angle *a* of Donders)[34] averages about five degrees in the emmetropic eye; it is somewhat greater in hypermetropic and less in myopic eyes, and in very high grades of myopia it may even be negative, so that the visual axis may cut the cornea at, or a little to the outer (temporal) side of, its vertex. Objective measurements of the interocular distance are, therefore, ordinarily a little too large, though sufficiently accurate for most practical purposes.

If we place a diaphragm, with a central perforation of about 1 mm. in diameter, in each of the two clips of a trial spectacle frame, and adjust the distance of each from the median line of the nose so that a distant vertical line shall be seen bisecting the small circular field as defined by the margins of the perforation, the distance between the centres of the two perforations will be the true measure of the distance of the two (parallel) visual axes from each other.[35]

To measure any deviation of the optic axes from parallelism, when the patient fixes his gaze upon a distant object, a lighted candle may be held about a foot in front of the deviated eye and moved in different directions until its image, as seen reflected on the cornea, occupies a position central to the pupil when viewed from a station just behind the light. The angle at which the light must be held to one side of a line drawn from the observed eye to the (distant) point fixed by the other eye is the measure of the angular displacement of the deviated eye; it may be conveniently measured upon the arc of a perimeter, the eye whose deviation is to be measured being at the centre of curvature of the arc (Landolt).

Ophthalmotropometry—from ὀφθαλμός, eye, and τροπή, turning—is the measurement of the movements of the eyeballs. Most important, from a clinical standpoint, is the estimation of the interrelation of the recti interni and recti externi muscles.

In insufficiency of the recti interni, not amounting to strabismus divergens, the phenomenon of double vision (see *Diplopia*) does not ordinarily manifest itself so long as it is possible to maintain the fusion of the two retinal images through the forced exercise of the convergence; if, however, we displace one of the retinal images upward or downward, by means of a weak prism, any insufficiency of the interni immediately reveals itself by a crossing of the images, which then assume an oblique direction, one to the other, instead of the vertical direction proper to the action of the prism. The measure of the insufficiency is the prism, with edge turned horizontally outward, which is required to convert the oblique into a vertical diplopia. This test, which may be applied both at a long range and at shorter distances, reveals the state of the convergence as related to the degree of accommodation which is brought into play at the particular distance.

The "glass-rod" test of Maddox (see Vol. III., p. 492), especially in its later form as developed by its inventor, is even more convenient in use, and is of wider applicability than the vertical prism. By rotating the disc of fluted glass in front of one of the eyes, the resultant bright streak may be given any desired direction, from the vertical to the horizontal, thereby revealing a deviation of the visual axes from parallelism in any direction. The measure of the deviation is the prism, or sum of two prisms before the two eyes, which brings the streak through the flame.

Insufficiency of the recti externi, or preponderance of the recti interni, is tested, *mutatis mutandis*, in the same manner as insufficiency of the interni.

Binocular vision, conditioned on the simultaneous perception and comparison of the two retinal images of the

FIG. 3702.

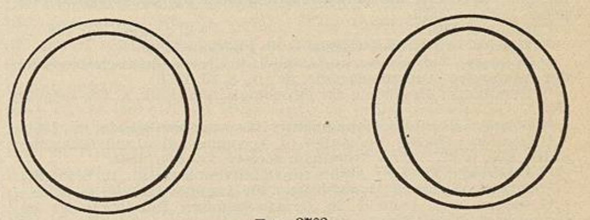

FIG. 3703.

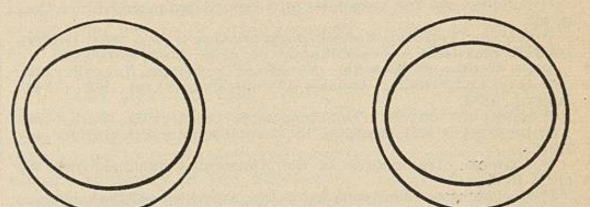

FIG. 3704.

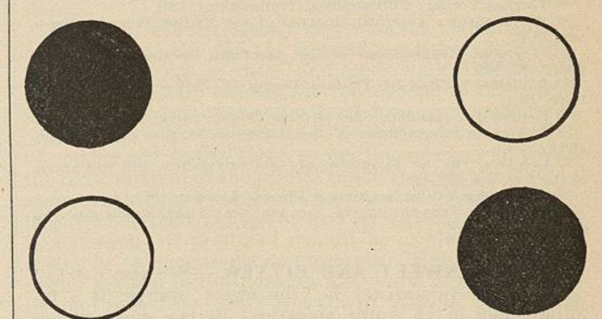

FIG. 3705.

object upon which the two eyes are directed, is most easily tested by means of the stereoscope. Rejecting all representations of objects in which solid forms are suggested by perspective, as is almost always the case with photographs of objects in nature, we make use of diagrams of the simplest possible construction; a few examples of these are shown in Figs. 3702 to 3705.[36]

Viewed in the stereoscope Fig. 3702 is seen as two discs, the one vertically above the other, but lying in two different planes at different distances from the observer; the more distant of the two discs appearing also to be the larger. Inverting the slide in the stereoscope, the relative distances and sizes of the discs appear reversed. Fig. 3703 shows a circle and an ellipse, which may be considered as two different perspective views of another, larger ellipse; when the two images are combined in the stereoscope a horizontally elongated ellipse is seen rotated about its vertical diameter as an axis; inverting the slide, the ellipse is seen rotated in the opposite direction. In Fig. 3704 the ellipse is seen to tip backward or forward, according as the slide is placed in the stereoscope in the position shown in the plate, or inverted. Fig. 3705 shows a combination of a ring with a white centre and a black disc of the same diameter; the effect is that of a mirror or of a shining surface polished with plumbago.

John Green.

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ORANGE, SWEET AND BITTER.—(See also *Citrus.*)

I. *Citrus Aurantium* L., the sweet orange, is a familiar plant in all warm countries. It is a small, rather slow-growing tree, with hard wood, an upright, much-branched trunk, bearing a well-rounded, rather close head. Leaves numerous, thick, evergreen, smooth, and shining, oval; the blade articulated to the distinctly winged petiole. Flowers axillary, perfect, regular, large, fragrant, white; calyx short; petals five, long, fleshy, spreading; stamens numerous; ovary free, eight- or more celled, several ovules in each cell. The leaves and petals are fragrant, and show by transmitted light pellucid spots indicating the large oil reservoirs in their parenchyme.

II. *C. vulgaris* Risso, the source of the bitter or Seville orange, is a smaller tree, with a closer head, larger, more fragrant flowers, and a rougher, darker, sour, and bitter fruit. This plant is also rather more spiny than the other, and propagates more truly from seed.

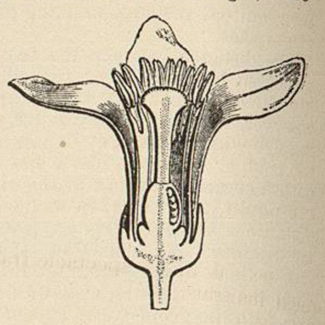

FIG. 3706.—Sweet Orange Flower. (Baillon.)

The official products and preparations are as follows:

Sweet Orange Peel. Aurantii Dulcis Cortex. "The rind of the fresh fruit of *Citrus Aurantium* L." The preparations of this are the five-per-cent. syrup, used wholly as a vehicle and for flavoring, and the twenty-per-cent. tincture, chiefly used like the last, but a stimulant in doses of 2–8 c.c. (fl. ʒ ss.–ij.).

Bitter Orange Peel. Aurantii Amaræ Cortex. "The rind of the fruit of Citrus vulgaris Risso."

Preparations, the fluid extract, dose 2–4 c.c. (fl. ʒ ss.–i.) and the twenty-per-cent. tincture, dose 2–8 c.c. (fl. ʒ ss.–ij.). It will be observed that this peel may be used dry, while that of the sweet orange must be used in the recent state. The bitter principle of this peel makes it an important aromatic bitter, as well as a flavoring agent.

Oil of Orange Peel. Oleum Aurantii Corticis. "A volatile oil obtained by expression from the fresh peel of either the sweet or the bitter orange." This is purely a diffusive stimulant, but is almost wholly used for flavoring. Its preparations are the five-per-cent. spirit and the twenty-per-cent. compound spirit, made with five per cent. of oil of lemon and two per cent. of oil of anise. This latter enters into the aromatic elixir.

Oil of Orange Flowers. Oil of Neroli. Oleum Aurantii Florum. A volatile oil distilled from the fresh flowers of the bitter orange. (The flowers themselves are no longer official.) This is used purely as a perfuming and flavoring agent. The following are the preparations: *Stronger Orange Flower Water* (*Aqua Aurantii Florum Fortior*) is obtained as a by-product in the distillation, being the water so used, saturated with the oil. From this is made the *Orange Flower Water* (*Aqua Aurantii Florum*) by mixing it with an equal volume of distilled water. From this, in turn, is made the syrup, by adding to 850 grams of sugar enough of the water to make 1,000 c.c.

Oil of Petit Grains, not official, is distilled from the unripe fruits of the bitter orange, and is very similar to oil of orange flowers, but much less agreeable.

The use of orange fruit is like that of other laxative fruits, with the special effect of citric acid. It is to be borne in mind that, while a moderate use of oranges is wholesome, the excessive use can bring on very stubborn and severe dyspepsia, especially in tropical countries.

Henry H. Rusby.

ORBIT, DISEASES AND INJURIES OF THE.—These affections have great interest and importance, not only with reference to the preservation of sight, but also on account of the close topical and vascular connection of the contents of this cavity with other parts, particularly the brain, and the difficult and serious problems in diagnosis and prognosis which they frequently offer. They are, comparatively, not very common. The one most frequently met with is

ORBITAL CELLULITIS.—This is not generally difficult to recognize. It is usually an acute disease, and often of a violent inflammatory character. Pain, which is a prominent symptom, is in proportion to the degree of swelling and consequent pressure, and, when this is excessive, it is very intense. It is referred to the ball and orbit and to the parts of the face to which the ramifications of the ophthalmic branch of the fifth nerve are distributed, and is always increased by the slightest backward pressure of the globe. The conjunctiva is congested and soon becomes chemosed, and the lids are swollen and œdematous and have an erysipelatous appearance.

The most striking symptom is the exophthalmus, which is decided, even in slight cases and in the early stages. The diplopia resulting from displacement of the eyeball is sometimes among the first symptoms, and may even occur before the exophthalmus attracts attention. In severe cases, particularly if an abscess is formed, the protrusion of the ball may be so great that the lids can no longer cover the cornea. The movements of the eye are, of course, restricted and painful, or it may be completely fixed in its unnatural position.

More or less constitutional disturbance is to be expected, and the formation of pus is usually announced by well-marked rigors. Suppuration is the rule, but a few cases end in resolution, a result said to be much more frequent in children than in adults. This form of the disease is sometimes called "œdematous cellulitis." When an abscess is evacuated spontaneously, the pus escapes through the skin of the lids, near the superior or inferior orbital margin, or sometimes behind the lids, through the palpebro-ocular fold of the conjunctiva. In the latter case the disease is sometimes mistaken for purulent conjunctivitis. In rare cases orbital cellulitis assumes a chronic form, and ends by the escape of pus only after the lapse of months or years. There may be little or no pain, and no decided symptom except the exophthalmus. There is likely to be periostitis or caries in such cases.

Etiology.—Idiopathic cellulitis is so rare that Pagenstecher is disposed to deny its occurrence, and to maintain that cases described as such have been due to the extension of inflammation from a focus which had escaped the attention of the observer (*Arch. of Oph.*, vol. xiii.). Primary cellulitis in healthy adults must be considered, to say the least, a very unusual affection, but its occasional occurrence in delicate children is generally admitted. Perhaps the most frequent causes are direct injuries of the orbital tissue and extension of local inflammation from neighboring parts. Operations upon the appendages of the eye, or even upon the ball itself, are sometimes followed by this complication. Bull (*Jour. Med. Sci.*, July, 1878) reports a case following excision of a prolapsed iris, and one after iridectomy for glaucoma. The most frequent cause of orbital abscess is empyema of the accessory cavities of the nose with caries of their walls. Phlegmonous erysipelas of the face has extended to the orbital tissue in a number of cases. Finally, orbital abscess may be the result of a metastatic process in puerperal fever, phlebitis, typhus, carbuncle, etc. While thrombosis of the orbital vein necessarily occurs in orbital phlegmon, and may extend to the cavernous sinus, orbital cellulitis may have its origin in suppurative phlebitis of the ophthalmic vein. It is well known that suppuration may be communicated to the ophthalmic vein and cavernous sinus from abscesses of the lids or lips, operations about the face, the extraction of teeth, and especially from facial erysipelas. In a fatal case of suppurative phlebitis of the ophthalmic vein and cavernous sinus, following malignant abscess of the tonsil, Professor Panas (*Arch. d'Ophthal.*, t. v.) thinks that the disease was communicated through numerous anastomoses which have been shown to exist between these vessels and the spheno-palatine vein. Cases of orbital cellulitis following diphtheria are reported by Knapp and Heyl (Nettleship, "St. Thomas' Hospital Reports," vol. xi.). Knapp (*Arch. of Oph.*, xiii.) has shown that orbital cellulitis is present in all cases in which blindness results from facial erysipelas.

Diagnosis.—The conditions with which orbital cellulitis is most likely to be confounded are periostitis of the orbital walls and new growths in the cavity. In periostitis the progress of the disease is usually less rapid, and the pain, though perhaps less severe, is an earlier symptom and may even be the first. Except in cases in which only the deeper parts of the orbit are affected, a tender spot can frequently be detected by passing the finger as far back as possible and pressing against the wall. While in cellulitis the eye is usually protruded directly forward, and its motions are limited equally in all directions, it is likely to be given a special direction by the more localized swelling of periostitis. These two lesions may, however, sometimes appear together, the inflammation extending from the periosteum to the orbital cushion. The acute course of cellulitis will usually distinguish it from orbital growths. The eye is rarely protruded directly forward by a tumor, and the latter may often be felt with the finger. The diagnosis is, however, sometimes extremely difficult, and may prove a stumbling-block to the most skilful and careful observer. This is well illustrated by a case which occurred some years ago in the experience of no less an authority than Professor Jaeger. He was sent by the Emperor to Milan to examine Marshal Radetzky, who had been suffering for three months with a high degree of exophthalmus and its accompanying symptoms. He reported that the patient, who declined any operative interference, was affected with scirrhus of the soft parts of the orbit, which would probably soon end his life. Not long afterward, under homœopathic treatment, there was a copious discharge of pus, and the eye returned to its normal position (*Annales d'Oculist.*, xxiii., p. 14).

Prognosis.—Though a large proportion of cases of orbital cellulitis recover without serious injury to the eye, the disease is a dangerous one and places not only sight but sometimes life in peril. The most frequent causes of loss of sight are injury to the optic nerve from pressure and stretching, and interference with the circulation in the central vessels of the retina. The tense chemosis may cause the cornea to slough, or panophthalmitis may result from interference with the circulation of the choroid or from direct extension of the inflammation to that membrane. The movements of the ball are sometimes permanently impeded by cicatricial contractions or atrophy of the external muscles, or their paralysis from injury to the nerves. Life is threatened by direct extension of inflammation to the meninges, through the sphenoidal fissure or optic foramen, by flow of pus into the intracranial cavity, or by thrombosis of the ophthalmic vein. According to Berlin (Graefe-Saemisch, vol. vi.), fatal pyæmia may result without extension of thrombosis beyond the orbit, or the thrombosis may extend to the brain sinuses. He thinks that the latter condition may be diagnosticated positively if exophthalmus occurs suddenly in the other eye. Exophthalmus frequently results from venous obstruction only, with little or no inflammation of the orbital tissue, and is a constant and important symptom of phlebitis of the cavernous sinus.

Treatment will necessarily vary with the violence of the local inflammation and the general condition of the patient. In traumatic cases, and others occurring in persons in fair health, leeches may be applied to the temple in the early stages of the affection before suppuration has commenced. Even this kind of depletion, however, is to be condemned in the large proportion of cases in which the inflammation of the orbital tissue is a complication of some exhausting disease. Hot stupes will promote resolution while there is hope of that termination; but warm fomentations or poultices should be applied when it is desirable to encourage suppuration. Extract of belladonna applied to the temples and brow is useful in relieving pain, but most cases will require the liberal exhibition of anodynes. When suppuration is evident, there is no question about the propriety and urgency of free incision, and when it is doubtful it is often prudent to make an exploratory puncture. When great swelling inflicts intense pain and threatens the integrity of the eyeball and optic nerve, deep and free incisions should be made without waiting for indications of suppuration, and with a view to relieving the tension of the parts. A narrow, straight bistoury or a long Graefe cataract knife